



Grupo de Ingeniería

Power and Environment



## **OBJECTIVES AND FIELDS OF ACTIVITY IN THE ENERGY AND THE ENVIRONMENT AREA**

- **BUSINESS AREA OBJECTIVES:**
  - Development of **new technologies** in waste treatment and power generation
  - **Promotion and development** of new business opportunities
  - **Incorporation and participation in companies** to own and manage the new businesses
  - **Operation and maintenance** of their industrial units
  
- **FIELDS OF ACTIVITY:**
  - Waste to energy plants
  - Pig manure treatment (cogeneration)
  - Used oil re-refining
  - Solar thermal power generation
  - Biodiesel
  - Biomass



### WASTE TO ENERGY PROJECTS

- SENER has developed and patented high efficiency thermal cycles for generating electrical energy from MSW (municipal solid waste), achieving:
  - A low level of corrosion in the furnace that increases the plant availability
  - Higher energy efficiency than conventional technologies, especially when combined cycles with fossil fuels are used.
- The configuration of these cycles may be adapted to different qualities of MSW, varying amounts of natural gas and varying power levels
- The furnaces and the systems for the treatment of combustion gases and ash comply with European standards

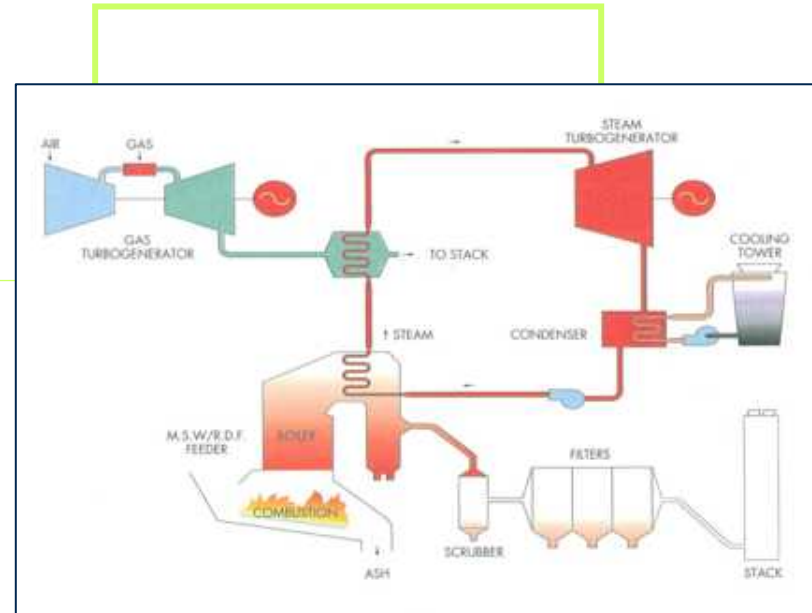


Diagram of Sener's high efficiency thermal cycle



### ENERGY RECOVERY FROM MUNICIPAL SOLID WASTE



MSW Treatment capacity:	225,000 tpa in the first phase
Output:	93 MW of electricity
Investment:	160 million euros
Start up:	2004
SENER's shareholding:	30%

- Mixed private-public ownership company that treats MSW in the Bilbao area
- New, clean, high performance energy recovery process, conceived and developed by SENER
- A SENER promotion, included in the MSW Management Plan of the Vizcaya Provincial Council.
- Based on the success of ZABALGARBI, a new production line, similar to the existing one, is being considered



Zabalgarbi (Biscay) plant



### TREATMENT OF PIG MANURE

- SENER has developed **anaerobic pig manure codigestion technologies** that:
  - Avoid the greenhouse gases emitted when pig manure is applied as fertiliser
  - Suppress the unpleasant odours that result from this application
  - Recover the renewable energy contained in the pig manure as a combustible gas (biogas) or as electrical energy
- SENER's process for **the codigestion of pig manure followed by separation of ammonia** by evaporation (SENER's ADEPUR process) makes it possible to reduce the nitrogen content, thus allowing the application of a greater quantity of manure over a smaller agricultural area
- **The VALPUREN® process**, used in the treatment of pig manure, combines codigestion with additional treatment stages that convert the anaerobically digested pig manure into a solid organic-mineral fertiliser that can be transported and applied in distant agricultural areas



Anaerobic codigestion in Juneda



### TREATMENT OF PIG SLURRY



Treatment capacity:	100,000 m3 per annum
Output:	5,500 tpa of fertiliser 16.3 MW of electricity
Start up:	2001
SENER shareholding:	35%

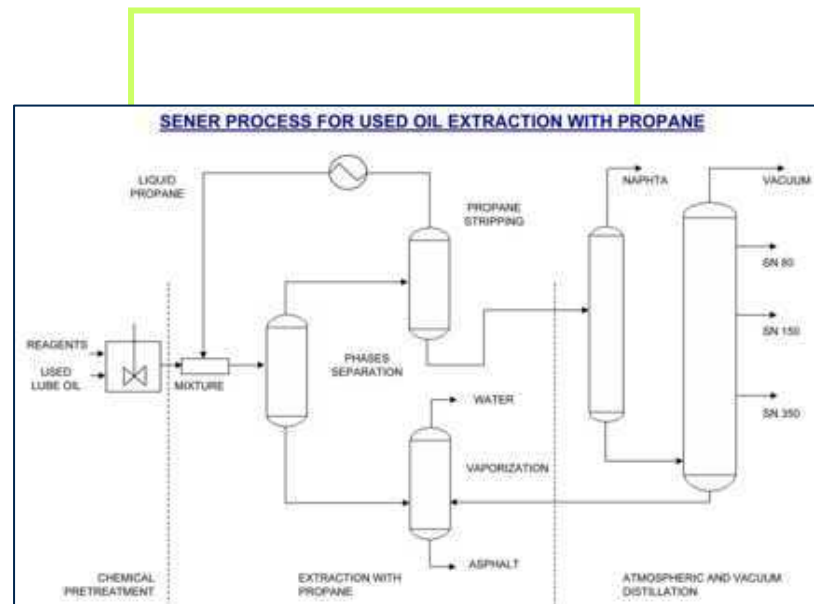
- TRACJUSA operates a pig manure treatment plant using the VALPUREN® in Juneda (Lleida/ Spain)
  - Since 2004, VAG S.L has been running another identical plant, which is also situated in Juneda
  - In 2009, SENER Ingeniería y Sistemas S.A has put into operation two plants, with the same characteristics, for:
    - VALPUREN BAÑUELO, S.L. in Polan (Toledo/ Spain)
    - VALPUREN COMATUR, S.L. in Consuegra (Toledo/ Spain)
- SENER is the majority shareholder in both companies





### USED OIL RE-REFINING

- **A new process**, developed and patented by SENER
- The plant produces **lubricant base oils** from used oils.
- Advantages:
  - High **quality** re-refined base oils
  - High base oil **yields**
- The technology is characterised by:
  - Base oil separation by **solvent extraction**
  - **Continuous operation**, fully automated
  - Plant **availability** higher than 8,000 hours per annum.
  - **Does not require hydrogen**
  - **High environmental quality**: it does not generate odours, does not produce waste (acidic sludges, clays, etc.)
  - **Competitive in terms of investment and costs** even at moderate production capacities (25,000tpa)



Bronze 2003 Sener

## RECYCLING USED LUBRICATING OILS



Treatment capacity:	30,000 tpa of used oil
Output:	20,000 tpa of base oil
Base lubricants:	6,000 tpa of asphalts
Location:	Fuenlabrada (Madrid)
Start up:	March 2000

- Technology and business promotion of SENER Grupo de Ingeniería, S.A.
- Design and construction (EPC), carried out by SENER Ingeniería y Sistemas, S.A.



ECOLUBE plant (Madrid)





### SOLAR THERMAL POWER GENERATION

- SENER ACTIVITIES IN THIS FIELD
  - Technology development
  - Project promotion
  - Detail engineering and design
  - Construction (“turnkey” projects)
  - Shareholding and plant management
- SOME TECHNOLOGICAL DEVELOPMENTS
  - Heliostat and receiver for central tower technology (CT)
  - Parabolic troughs collectors (PT)
  - Heat storage systems (molten salts)
  - Software for design and simulation
- PLANTS BY TORRESOL ENERGY, S.A. (60% SENER, 40% MASDAR)
  - GEMASOLAR (CT)
  - TERMESOL (PT)
  - ARCOSOL (PT)
- OTHER PROJECTS BEING BUILT WITH SENER ENGINEERING & CONSTRUCTION SERVICES:
  - ANDASOL-1
  - ANDASOL-2
  - EXTRESOL-1

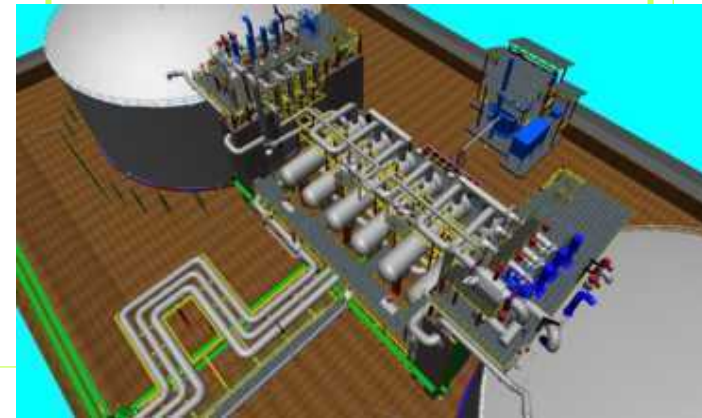


Heliostat developed by SENER being tested



### CONCENTRATING SOLAR POWER

- TORRESOL ENERGY promotes the development and operation of large CSP plants worldwide. Torresol is a leading company in the concentrating solar power sector due to its cost effective technology and efficient projects
- The company, founded in 2008, is the strategic alliance between SENER (60%) and MASDAR (40%)
- Torresol Energy's key strategy areas are: Southern Europe, Middle East and North Africa, and the South West of the USA
- Solar energy is a clean, inexhaustible and environmentally friendly energy for the future generations



Molten salts storage system

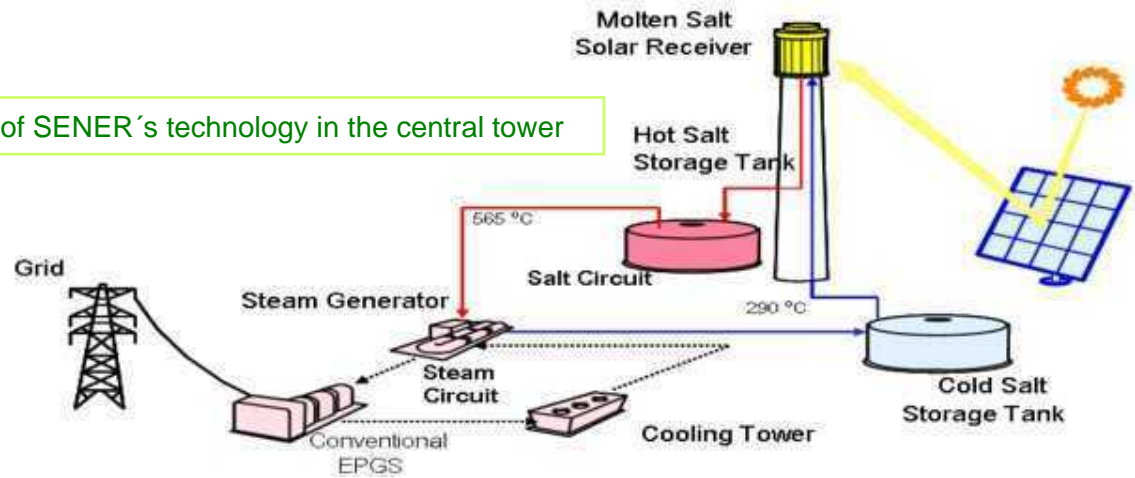
# CONCENTRATING SOLAR POWER



Electrical power generated:	17 MW
Availability:	15 hours
Production hours:	6,500 h/a
Carbon emissions saving:	90,000 t/a
Households consumption:	30,000
Location:	Seville

- Pioneering central tower and heliostat project, using SENER's technology and design for the receiver, and for the heat storage with molten salts
- World largest commercial unit of this type of technology

Diagram of SENER's technology in the central tower



Central tower plant



### CONCENTRATING SOLAR POWER



Electrical power generated:	50 MW/plant
Availability:	7 hours each
Production hours:	3,600 h/a per plant
Carbon emission saving:	155,000 t/a per plant
Households consumption:	45,000/plant
TERMESOL & ARCOSOL´s locations:	Seville and Cádiz

- Solar plants based on the PT collectors technology with molten salts storage system
- These plants incorporate SENER´s technologies in the collector structures and storage systems



CCP Collector disinged by SENER

Molten salts tank



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